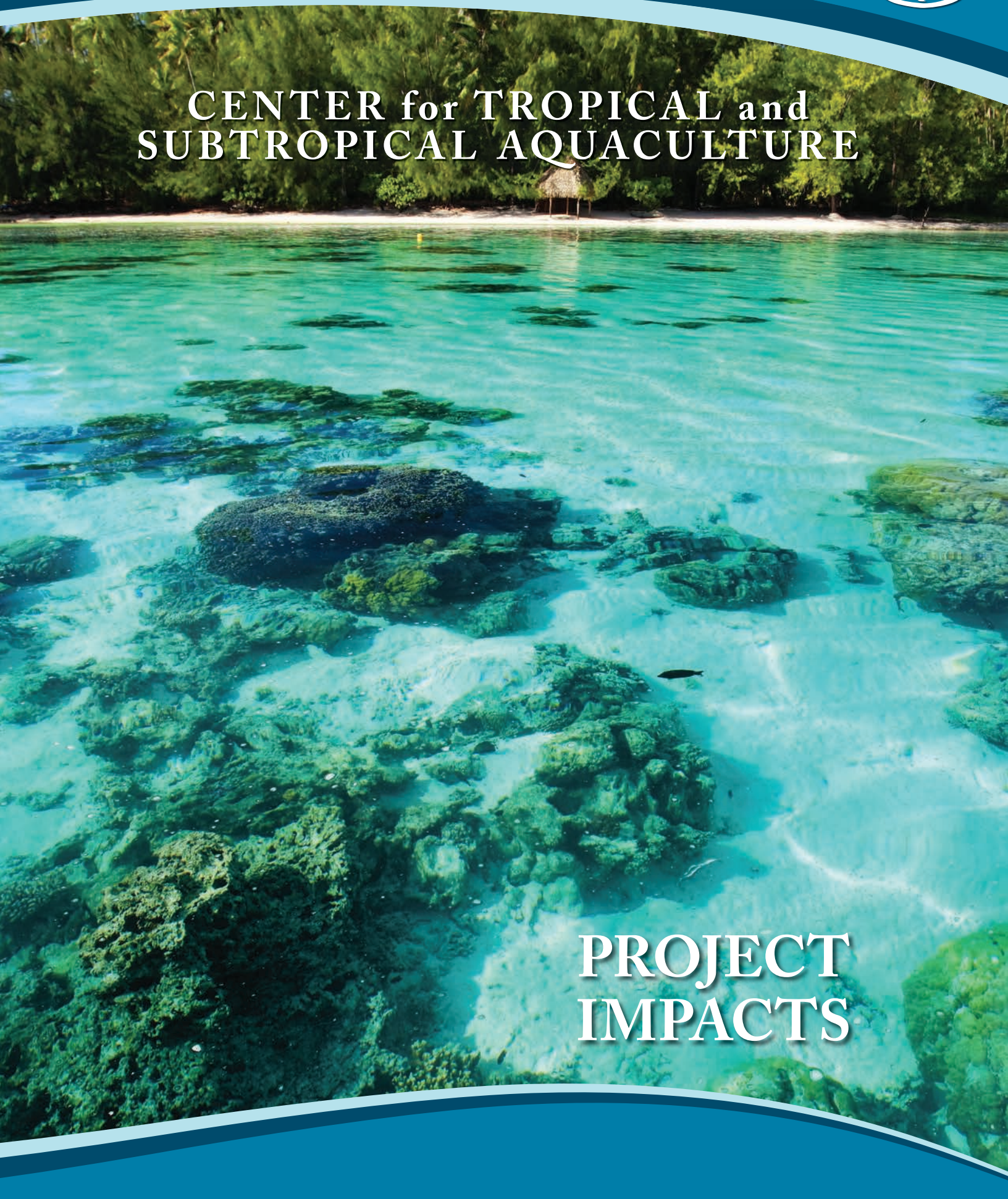
CTSA

CENTER for TROPICAL and SUBTROPICAL AQUACULTURE



PROJECT IMPACTS

CENTER
FOR
TROPICAL
AND
SUBTROPICAL
AQUACULTURE

CTSA PROJECT IMPACTS

1986 – 2013

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Center for Tropical and Subtropical Aquaculture

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Giant clam photo, pg. 14, NOAA – Map pg. 7, CIA – Making feed in American Samoa, Pg. 12, www.Aquafeed.com – Fish in cage, pg. 23, Kampachi Farms – Hawaiian Oyster photos: Bivalve Culture in Hawaii: Maria Haws, Pacific Aquaculture and Coastal Resources Center, UHH, Sea Grant, and Robert Howerton Sea Grant, UH-Maui – Koi fish, pg. 18, Belinda Cumming, http://www.sxc.hu – Chinese catfish, pg. 17, http://www.torange.us/Objects/Meal-and-drinks/Channel-catfish-6007.html

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Aloha,

Thank you for taking the time to learn about CTSA and the RAC program's impact on aquaculture in the Pacific Region! As you read, you'll see that CTSA is making lasting and valuable contributions to fish farming all over this region, proving daily that aquaculture makes good sense on a global scale.

Guided by industry concerns and under the expertise of various technical advisors, the Regional Aquaculture Centers (RACs) produce annual programs of directed research that target industry priorities. Our Industry Advisory Council offers an open forum through which aquaculture stakeholders can provide comments, suggestions and advice on industry needs, with the goal of increased profitability. Our Technical Committee evaluates the scientific merit and suggests technical improvements for projects included in our annual Plan of Work, while the Board of Directors is responsible for approving the Plan of Work and overseeing the programmatic functions of the Center.

We appreciate your interest in our work, and hope this publication contains information on the global impact of aquaculture in the Pacific Region that is useful and of value to you.

Mahalo,

CTSA Board of Directors

Aquaculture...

Good sense on a global scale

"With earth's burgeoning human population to feed we must turn to the sea with understanding and new technology. We need to farm it as we farm the land."

Jacques Cousteau *(1910-1997)*
Explorer, Conservationist, Filmmaker, Innovator, Scientist, Photographer, Author and Researcher

Around the globe, aquaculture has catalyzed economic growth and fed communities. It is a common-sense solution to a multitude of global challenges. It is a superb source of low-cost, high-quality protein. It leaves minimal impact on an increasingly fragile environment. *Aquaculture: it makes good sense on a global scale.*

A Brief History of Aquaculture

Aquaculture, the production of aquatic organisms in controlled environments, has been practiced in several different forms around the world for more than 2,000 years.

Globally, aquaculture's role has become increasingly important. As a result of overfishing, pollution, habitat destruction, and human reluctance to consider marine life an exhaustible resource, traditional capture fisheries are no longer able to meet global demand.

By the 1970s, aquaculture was recognized as a reasonable alternative to the traditional capture fisheries in the United States. Aquaculture is now the fastest growing segment of the U.S. agricultural economy, and American producers are increasing their impact on the world market.

About Regional Aquaculture Centers (RACs)

In the United States, the U.S. Department of Agriculture has established five Regional Aquaculture Centers (RACs) with a common mission: to promote aquaculture research, development, and demonstration, to enhance viable and profitable commercial aquaculture production in the U.S. for the benefit of producers, consumers, and the American economy.

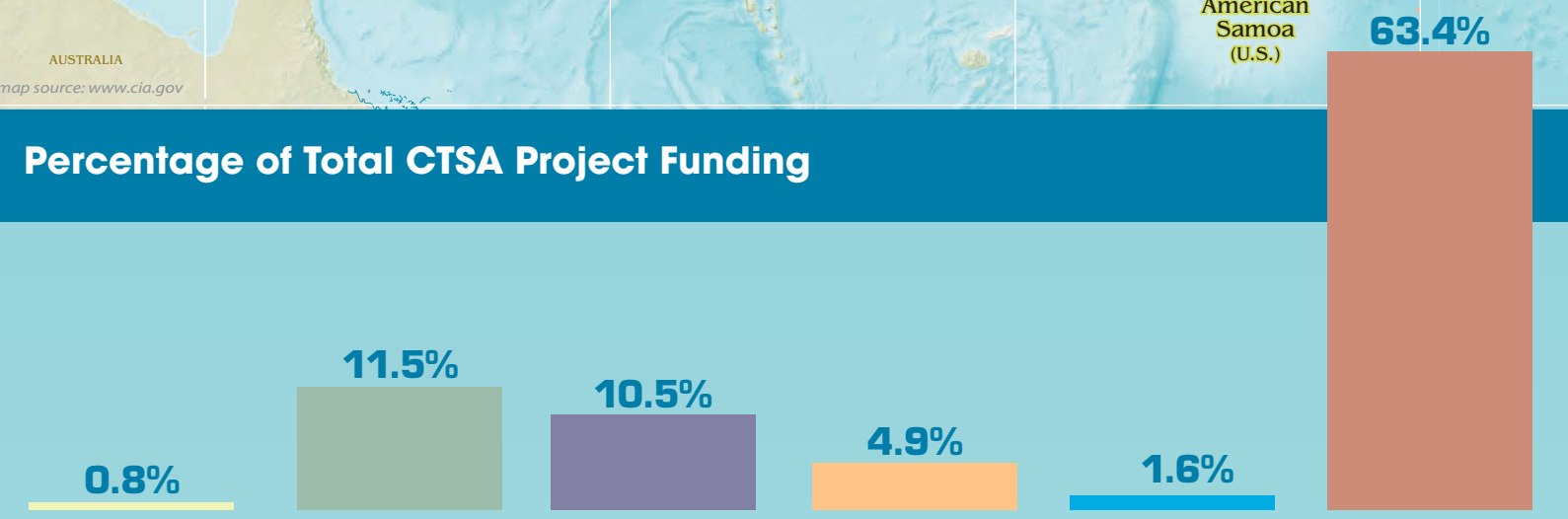
Supported through a grant from the National Institute of Food and Agriculture (NIFA), most of the RACs work within defined geographical regions in North America. However, the Center for Tropical and Subtropical Aquaculture (CTSA) is quite different from the other four RACs. The CTSA "region" encompasses tropical and subtropical species *wherever* they're cultured in the United States.

Center for Tropical and Subtropical Aquaculture

Currently, the CTSA "region" covers Hawaii and the American Insular Pacific (American Samoa, the Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia, Guam, the Republic of Palau, and the Republic of the Marshall Islands), though CTSA research has had impacts on Florida's ornamental industry. CTSA's projects tap the region's extensive resource base to meet the needs and address the concerns of the tropical aquaculture industry.

Administered by the Oceanic Institute and the University of Hawaii, CTSA was established in 1986 and operates from the Oceanic Institute's Makapu`u Point site on windward Oahu, with an additional office at the University of Hawaii.

Percentage of Total CTSA Project Funding



Palau	Guam & Northern Mariana Islands	Federated States of Micronesia	Marshall Islands	American Samoa	Hawaii
3 projects funded	30 projects funded	28 projects funded	10 projects funded	9 projects funded	150 projects funded
Total: $120,046	**Total: $1,686,653**	**Total: $1,539,530**	**Total: $713,672**	**Total: $239,607**	**Total: $ 9,290,762**

Aquaculture...

A path to global food security

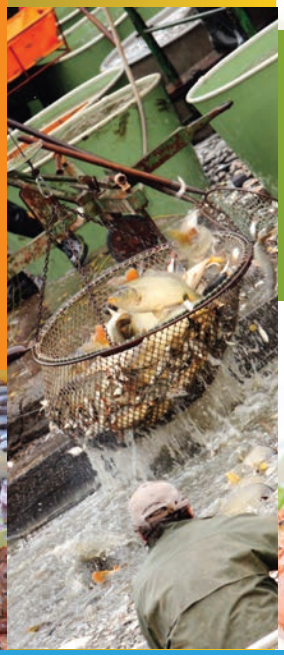
Food security requires consistent availability of sufficient, safe, nutritious food to maintain a healthy and active life.

FACTS & FIGURES

Nearly half of the seafood consumed worldwide is from aquaculture.

In 2011, the global value of freshwater and marine aquaculture production was about $136 billion. However, U.S. aquaculture only had a value of around $1.1 billion, just under 400,000 tons**.

The U.S. imports about 86% of its seafood; approximately half of those imports are products of aquaculture in other countries.

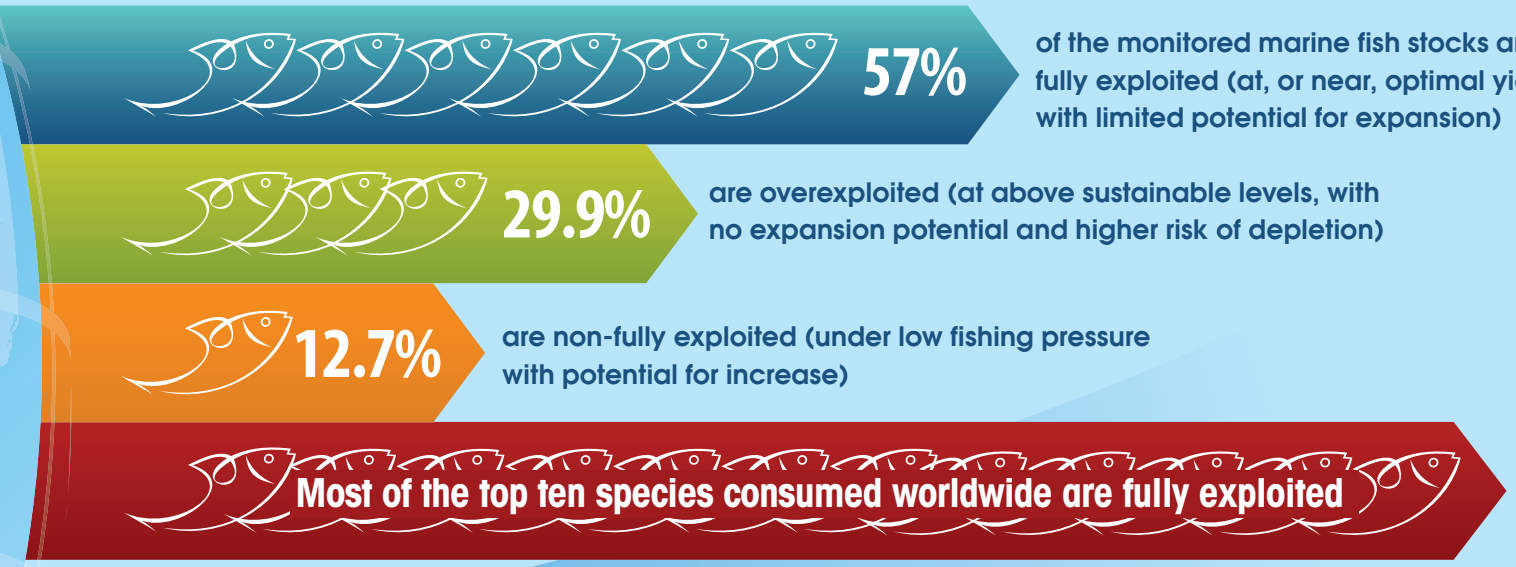


Only 5% of the seafood eaten in the United States comes from domestic U.S. aquaculture.

Among agricultural products, edible fisheries imports — valued at $16.6 billion in 2011** — make up the largest contribution to the U.S. trade deficit.

In 2010, the U.S. seafood trade deficit surpassed the $10 billion mark for the first time, reaching $11.2 billion in 2011.

Increased harvesting pressure impacts wild seafood stocks worldwide*



For centuries, Pacific Islanders and other coastal residents have depended on fish as their main dietary protein source. Globally, fish provides more than 3 billion people with almost 20% of their average per-capita intake of animal protein, and 4.3 billion people with 15% of their protein.*

But the security of fish as a dietary staple is in jeopardy. When we consider the effects of overfishing on our oceans, the fact that total production from capture fisheries has reached maximum yield worldwide (approximately 94.6 million tons in 2011), and the rapid rate at which Earth's population is growing, it is easy to see how seafood may become scarce — or unaffordable to all but the very wealthy — if we don't find a solution to over-exploitation.

Globally, aquaculture has grown to help meet burgeoning demand for edible seafood as capture fisheries' output has leveled off. Aquaculture in the Pacific Region can help islanders restore a sustainable food supply and cut down on the need to import food. It can also help vitalize rural communities and provide tools and resources to create economic growth. ***Food security, self-reliance, and economic gain are completely within reach, with aquaculture as a means to attain them.***

Aquaculture... Feeds our people, supports our economy, & can help save our oceans.

*Food and Agriculture Organization of the United Nations,State of World Fisheries and Aquaculture 2012
** Food and Agriculture Organization of the United Nations,Online Fishery & Aquaculture Statistics 2013

CTSA supports...
Conservation of Wild Seafood Stocks

CTSA has helped initiate and improve culture techniques for important marine species in the Pacific Region. In particular, significant research and demonstration efforts have been devoted to moi (Pacific threadfin) and kahala (amberjack).

- Early projects developed broodstock husbandry, larval rearing, and grow-out techniques, and led to moi and kahala aquaculture in Hawaii. Other projects developed and improved culture factors like feed formulations, best management practices, and live fish transfer techniques.
- Distribution of more than one million fingerlings, and on-farm technical assistance, have resulted in better on-farm survival rates for moi and kahala.
- Moi and kahala research supported by CTSA led to the introduction and improvement of open-ocean cage culture technology in Hawaii.
- More than one million cultured moi fingerlings have been restocked in Hawaiian waters, helping to replenish their overfished wild population.
- In a recent project, CTSA researchers developed a parentage DNA test for moi. This will aid monitoring of captive and wild stocks and the selection of fast-growing fish for broodstock.

The Center hopes to bring additional important species into aquaculture.

- Opihi are a high-value limpet in Hawaii. The Center is currently sponsoring a project to close the life cycle of the opihi, which has been overfished in the wild. "Closing the life cycle" means that researchers will spawn the shellfish in captivity and grow them to maturity, and then encourage the mature shellfish to spawn.
- Hawaiian oysters (*endrostrea sandvichensis*), a delicious indigenous species, have been successfully spawned and grown out as part of a CTSA project to introduce bivalve culture in Hawaii. The project demonstrated the feasibility of culturing the oyster and other edible bivalves, facilitated the bivalve certification process, and made significant advances to help Hawaiian fishpond operators to grow shellfish in coastal areas.

"There is a tremendous opportunity to develop new technologies in Hawaii that can help with the looming seafood crisis. The exciting thing for me as a fisheries biologist and a passionate environmentalist is working on developing those technologies with people and organizations such as CTSA that share a commitment to produce great tasting seafood, and to do it in a really environmentally responsible manner."

Neil Sims
Kampachi Farms, Kona, Hawaii

"CTSA has supported important feed research in the Pacific region. These islands are home to an abundance of natural ingredients that can be used to make sustainable feeds and create industries and jobs in rural communities. With 50-60% of average operation costs going to feed, it is clear that the success of aquaculture in the Pacific Islands lies in improving this facet of the industry."

Warren Dominy
Director, Aquatic Feeds and Nutrition Department, Oceanic Institute

CTSA supports...
Aquatic Feed Development Using Local Ingredients

Limited availability and high price of aquatic feed are major constraints for fish farming in the region. CTSA has funded several projects that support the development of nutritious aquatic feed for cultured species. Notably, the Center helped develop artificial diets for moi, milkfish, and Chinese catfish in the 1990s. In recent years, there has been much focus on developing affordable feeds using locally sourced products and byproducts in the Pacific Region.

Using Local Products as Feed Ingredients

- Researchers developed a bioreactor system to produce yeast from sugar waste in discarded papayas, and investigated the possibility of using the yeast as an alternative protein source for feed. The yeast could replace up to 50% of imported protein ingredients without adverse effects on growth of the shrimp!
- A project in Guam led to the discovery that tuna roe, a by-product of local processors, can be used as a main ingredient in a shrimp maturation diet. This may help local producers reduce their dependence on costly imported blood worms.
- A local, artificial feed has been developed for abalone producers in Hawaii. Researchers are also investigating the possibility of using native algae species as a replacement for non-native algae currently used in commercial abalone diets.

Project Highlight – American Samoa Tilapia Feed

CTSA sponsored a project to develop tilapia feed made from ingredients found in American Samoa. Using fishmeal from a local tuna processor and ingredients such as bananas, breadfruit, and taro, researchers formulated a diet and developed a simple farm-site feed manufacturing system. Working with the Center's administrative staff, the group published a manual in English and Samoan with simple directions for producing the feed. Researchers also conducted a workshop to teach production methods to farmers and their families. Samoan tilapia farmers are now able to reduce feed costs and work with their families to support their farms.

CTSA supports...
Recycling Waste to Produce Food

Integrating plant culture with fish farming through aquaponics is needed to increase food security in the Pacific Islands and across the globe. CTSA sponsored one of the region's first research projects on aquaponics, and continues to seek opportunities to improve and share this technology.

- The first CTSA aquaponics project resulted in the development of a simplified modular tilapia and lettuce co-culture system. The system achieves maximum production yield through science-based methods and requires minimal electricity and simple equipment to run. Such requirements are ideal for the remote Pacific Islands, where energy shortages are frequent and expensive, high-maintenance mechanical components are impractical.
- Chinese catfish were successfully tested as alternative fish for aquaponics.
- New planting and harvesting schemes have cut grow-out time in half.
- The technology has been shared with other locations in the Pacific Region. In 2011, three aquaponics systems were constructed in American Samoa with the help of a project work group member, who stayed on-island through the first full growth cycle to train farmers. The systems are thriving, and at least one farmer has plans for expansion.
- Cost comparisons of different operations are being conducted, and will help farmers determine the most profitable system for their specific locations.

"I began my aquaponics farm with the help of the CTSA Aquaponics project. I am encouraged by the success we have experienced so far. The produce that is currently sold in our markets is imported from New Zealand, and it often has a very short shelf life. My goal is to expand my farm to about five raceways to provide fresh vegetables to the stores in place of the imported ones."

Apela Afoa
High Talking Chief and Tilapia Farmer, Taputimu, American Samoa

"CTSA is an organization that supports the exchange of aquaculture ideas and technology. This is critical in the remote Western Pacific Islands, where communities are in desperate need of economic revitalization. In addition, over the course of my company's development, CTSA and its sponsored research has been instrumental in providing resources and support to enhance our production."

Anthony Pellegrino
Saipan Aquaculture, Saipan, CNMI

NOAA image

CTSA supports...
Capacity Building in the Western Pacific

Prior to 1989, there was very little aquaculture in American Samoa, the Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia and the Republic of the Marshall Islands. CTSA's extension project has led to the establishment of aquaculture operations throughout the region, including giant clam hatcheries, pearl oyster farms, sponge farms, coral production facilities and tilapia farms. Awareness of aquaculture and its income potential has grown rapidly in the region.

- The extension project has provided education and training to farmers and government fisheries officers throughout the U.S. Affiliated Pacific Islands. Support included aquaculture training courses at various locations, providing scientific advice to private and public facilities, and assistance with reef surveys and reseeding programs for giant clams, sponges, pearl oysters and other species.

- Publications on the culture of a variety of species have helped farmers learn new technology, mitigate disease outbreaks, and build capacity. Other publications stemming from the extension project, such as "Spawning and Early Larval Rearing of Giant Clams," have been widely used in the establishment of commercial operations.

- Hands-on training has led to substantial capacity building in the region. From teaching giant clam farming to present-day training in half-pearl grafting and husbandry techniques, the emphasis of all CTSA extension work is on building local capacity.

- The CTSA extension agent has been training individuals in pearl oyster and sea cucumber culture in Pohnpei and on other Micronesian islands for the last several years. The program is now focusing on training technicians to become trainers themselves. This chain of knowledge, passed from CTSA through technicians to local youth, will empower residents of these remote islands to expand local aquaculture and increase production.

Project Highlights in the Western Pacific

CNMI Shrimp Demonstration

Through a recent demonstration project in the Northern Marianas Islands, researchers from Hawaii helped build a knowledge and technical base for shrimp farming in the CNMI and Guam, and stimulated interest in aquaculture in the region. Researchers also provided training on shrimp artificial insemination techniques, broodstock feeding, water quality management, and broodstock sourcing protocols. The workshop conducted under the project directly resulted in the establishment of the first shrimp farm on the island of Tinian, which is now the largest shrimp farm in the United States. A fact sheet on shrimp farming in the CNMI was also developed and distributed throughout the region.

Regional Marine Finfish Training

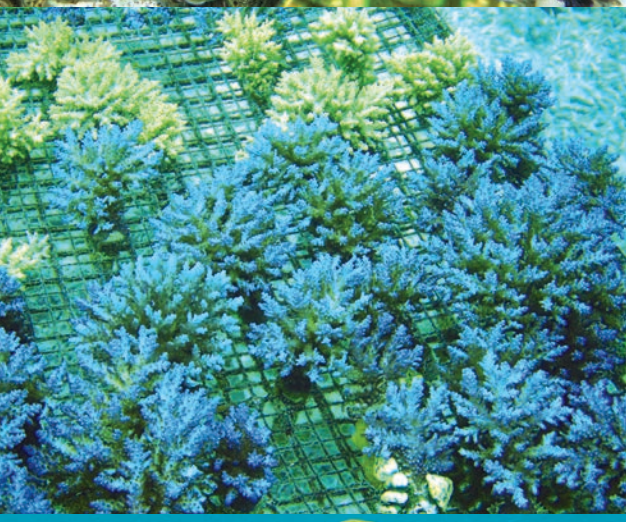
A project to introduce marine finfish aquaculture to the CNMI is having a significant impact on capacity across the region. Seven individuals from the CNMI, Marshall Islands, Palau and Hawaii participated in a two-week "Marine Finfish Hatchery Training" workshop held at the Oceanic Institute in August 2012. The technicians received practical, hands-on training in core broodstock, live feeds production and hatchery technologies. Prior to the workshop the project group identified desirable marine species for aquaculture in the CNMI, which are now being investigated further.

Aquaculture of Mangrove Crabs in Palau

Researchers released 350,000 mangrove crablets in Palau in December 2012 as part of an ongoing project to captively culture mangrove crabs in the island nation. The crabs were released in an effort to enhance local wild stocks. Mangrove crabs are a popular food item and a culturally important species, but their populations in Palau have suffered from overfishing and habitat destruction. The restocking was one component of the project, which is developing husbandry and rearing techniques.

"If we don't control the way we are harvesting from our reefs, we will lose most and maybe all of our fisheries in the next ten years. I believe aquaculture will help us improve sustainability."

Eugene Joseph,
Conservation Society of Pohnpei



CTSA supports...
Conservation of Coral Reefs

Marine ornamentals — fish and marine animals bred or caught wild for aquariums all over the world — are a huge industry, both in the U.S. and abroad. However, unsustainable collecting practices are harmful to coral reefs. Aquaculture can help to conserve these precious resources by generating products to supply the global industry.

- CTSA's research on ornamentals like featherduster worms, soft and hard corals, yellow tangs, and flame angelfish has resulted in new culture technology, which may help to decrease fishing pressure on wild stocks of these important reef species, many of which have been overharvested for the aquarium industry.
- CTSA sponsored the first captive hatchery production of flame angelfish.
- In the 1990s, the CTSA Extension project shared technology for cultivating marine ornamentals with farmers on the outer Pacific Islands. This resulted in the initiation of several industries, including the giant clam farming in the Marshall Islands and coral, pearl, and sponge farming across the region.
- Work in Guam resulted in the propagation of several species of hard and soft coral.
- Projects to develop and improve featherduster worm culture resulted in the establishment of captive maturation and spawning techniques.
- Researchers made progress on harlequin shrimp aquaculture in Hawaii, contributing improved culture techniques and new information about dietary requirements.

CTSA continues to work towards developing the marine ornamental industry. A recent project to close the life cycle of yellow tang resulted in their first recorded spawning in captivity. Although the life cycle has not yet been closed, these are promising steps towards that goal.

CTSA supports...

Increasing Production of Freshwater Food Fish and Ornamental Species

Research sponsored by CTSA has resulted in diversification and expansion of the freshwater ornamental and food fish industries in Hawaii. Studies of tilapia, catfish, pacu, koi, and swordtails have led to increased understanding and efficient propagation of these species, while considerable extension efforts have helped industry stakeholders implement research outputs on their farms.

Foodfish

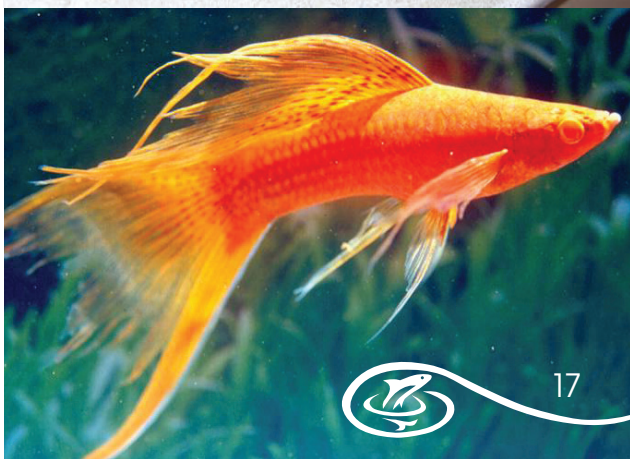
- Broodstock for tilapia, Chinese catfish, and other popular freshwater food fish have been bred for distribution to farmers. Studies have resulted in more efficient feeds, and extension services in the form of technical workshops, site visitations, and verbal consultations have enabled farmers to increase production.
- Tilapia stocks have been improved for commercial aquaculture in Hawaii and the Pacific Region. Local captive and feral populations in Hawaii have been identified and categorized to determine best growth characteristics, which may lead to an improved strain of the fish.
- Grow-out culture for Chinese catfish was improved through triploid and feed applications, and by the development of a new high-performance feed.
- Sturgeon hatchery and production efficiency in Hawaii were improved after several years of research.
- Red-bellied and black pacu were evaluated as suitable candidates for food fish and ornamental aquaculture in Hawaii.

Ornamental

- CTSA-sponsored researchers discovered that a dose of 400 mg/kg feed 17-estradiol results in 91-100% feminization of swordtails, and produces fertile fish.
- Publications about the culture of freshwater tropical fish, and various educational extension services, have been enthusiastically received by producers in the Pacific Region and Florida.

"My farm is a participant in the CTSA project to classify tilapia in Hawaii. Results of this research are valuable and have the potential to greatly benefit the future of tilapia breeding in the state. CTSA has also made it a point to reach out directly to local aquaculture farmers to assess our immediate and long-term needs, and I am appreciative of the Center's efforts to understand and solve the challenges we face."

Keith Steele
Tilapia Farmer, Honoka'a, Hawaii



"The KHV diagnostic services (CTSA has) provided to us... are quite helpful since our goal is to operate our business in a timely manner to meet the demand of the U.S. market. We are very grateful for the support."

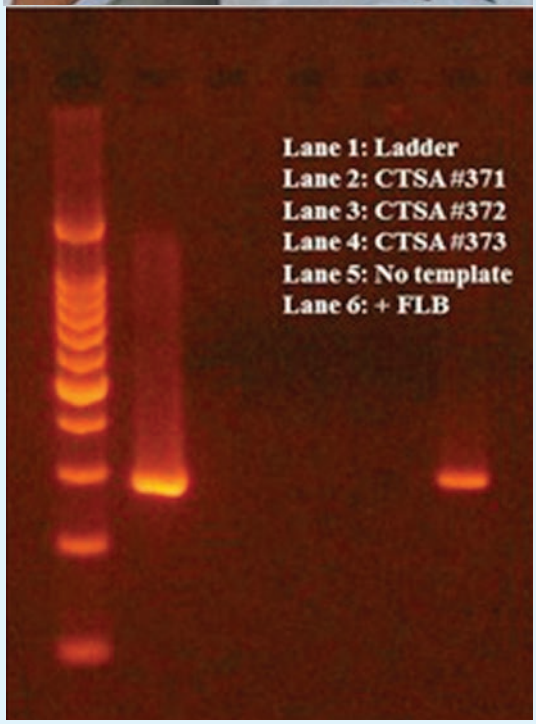
Taro Kodama
Kodama Koi, Oahu, Hawaii

CTSA supports...
Creating a Safe Seafood Industry

After more than a decade of effective management, diseases for a variety of aquacultured species have been mitigated or eradicated, resulting in fewer outbreaks of pathogenic viruses, ectoparasites, and other harmful aquatic disorders.

- Fish and shrimp farms, and commercial hatcheries, have received consistent diagnostic support, pathogen testing, and disease surveillance services with CTSA support.
- More than 25 manuals and extension publications have been produced to assist farmers with disease management and outbreak mitigation. Multiple workshops have been organized to both educate and receive input from commercial producers on a variety of health management issues.
- Researchers have established cell line cultures from several species, including Pacific threadfin and bluefin trevally. These cell lines will be useful for aquaculturists researching new diseases that affect fish culture in Hawaii.
- Proactive screening methods have been established for koi herpes virus disease (KHVD).
- Researchers identified factors that contribute to the occurrence of bacterial disease during grow-out of Chinese catfish (*Clarias fuscus*), and developed strategies to control those diseases.
- Surveillance of imported species has been conducted to document mortality patterns, portray environmental conditions, and determine the presence and prevalence of certain parasites and bacterial pathogens.
- Methods were developed to decontaminate shrimp ponds infected with the IHHN virus, a disease that has had disastrous impacts on farms.
- Protocols have been developed to monitor infections in cultured moi. These protocols have been shared with farmers, who have benefited from a decrease in disease.

- Researchers identified key risk factors in shrimp health management practices in Guam and Commonwealth of the Northern Mariana Islands by conducting biosecurity audits of all of the shrimp farms in both regions. They helped farmers implement new biosecurity protocols, decreasing the risk of disease outbreaks in the region.
- CTSA sponsored a disease management project to study the *capsalid monogenean* that infects kahala, capturing data that might help lead to a vaccine.
- CTSA and the other RACs joined to provide five years of support for the national coordinator for aquaculture new animal drug applications. Several important new aquaculture drugs were approved by the FDA as a result of this work.



PCR test results: *Franscisella* Primers

Project Highlight – *Francisellosis* in Tilapia

CTSA has supported several projects to mitigate a local outbreak of the disease *Francisellosis*, which has significantly affected cultured tilapia in Hawaii. The research group leading the effort has investigated the cause and control of the pathogen causing the outbreak, *Francisella-like* bacteria (FLB), laying the groundwork for development of a disease management program for this emerging pathogen. Researchers also created opportunities for farmers to have their stocks tested for the disease for a nominal charge, helping them avoid catastrophic stock losses.

"The PRAISE and Publications projects are an important part of the regional aquaculture industry. Literature searches and information dissemination services provided by this project are valuable to both farmers and researchers, helping us better meet the needs of our customers and industries."

Ron Weidenbach
CTSA IAC Chair
Hawaii Fish Company, Oahu, Hawaii

CTSA supports...
Regional Information Exchange

Exstensive Online Resources — PRAISE

Pacific Regional Aquaculture Information Service for Education (PRAISE) is a program that provides research support services that empower regional aquaculturists to compete in the business world. These services range from development of educational products to direct delivery of research information. PRAISE was the first program in the U.S. to provide aquaculture information services in the remote Pacific Region. It was also a model for other programs to emulate during the early stages of Internet information access. For a relatively small investment, the Pacific Region has had access to information that enables users to apply successfully for grants, design better facilities, increase production, generate quality merchandise, and market products. (http://praise.manoa.hawaii.edu)

- PRAISE is responsible for the "Pacific Island Gray Literature" project. Inaccessibility of gray literature — reports and other informally published material — is a serious problem in the Pacific Islands, where there are relatively few libraries or other sources of data or information. Through PRAISE, the wealth of reports produced throughout the Pacific Islands are being collected and distributed.
- Several thousand requests for direct assistance have been fulfilled and tens of thousands of articles have been delivered to requestors.
- PRAISE staff members have focused significant time on digitizing documents and compiling bibliographies that are relevant to aquaculture producers and researchers in the region.
- Bibliographies have been compiled for a variety of subjects, including alternative feeds, open ocean cages, and aquaponics systems.

CTSA Publications

The CTSA Publications project is an ongoing effort to share information with the regional aquaculture community, and to provide updates on the status of CTSA and other RAC projects.

- In conjunction with project work groups, CTSA has produced more than fifty publications, including fact sheets, manuals, and books.
- CTSA launched a new, more user-friendly website in 2011. The improved site is constantly updated with the latest news on regional aquaculture and CTSA projects, and features sections dedicated to farmer and public outreach (www.ctsa.org).
- A monthly e-newsletter, *Regional e-Notes*, is distributed to more than 1,000 readers — an audience that includes farmers, researchers, U.S. senators and other policymakers.
- The new CTSA video series profiles various aquaculture activities across the region. Created for both stakeholder and public audiences, the videos are helping to increase global understanding of aquaculture in the Pacific.
- A recent education and outreach project, completed in conjunction with NOAA under the auspices of the Publications project, resulted in the development of a 50-page curriculum about aquaculture in the Pacific Region. Other products from the project include materials that promote regional aquaculture activities, and a website designed to educate and inform the general public about aquaculture (www.pacificAQUA.org).

Project Highlight – Tilapia Feed Manual

Working with Oceanic Institute Aquatic Feeds and Nutrition researchers, the Principal Investigator of the Publications project wrote, edited, and published a children's manual, in both English and Samoan, containing easy-to-follow directions for producing tilapia feed. The manual has been popular in American Samoa, and stakeholders from other islands throughout the region have requested similar manuals based on their local ingredients.

"I have learned a lot from the oyster and sea cucumber projects, about chemical work, spawning the animals, microalgae cultures, and more. This is really important to me, for my future and my family's future, to have this kind of project."

Martin Hagilmai
Aquaculture Technician,
College of Micronesia, Pohnpei, FSM

CTSA supports...
Economic Development in Micronesia

Micronesia is an archipelago of beautiful, pristine islands with abundant natural resources. Historically, there have been limited opportunities for economic advancement in the region, resulting in a fledgling economy. Aquaculture has great potential as a source of economic vitalization, but building a sustainable aquaculture industry that can stand the test of time will require trained technicians. CTSA has sponsored several years of demonstration and training towards this goal.

- Two CTSA-funded projects (Black Pearl & Sea Cucumber) have resulted in hands-on training for local technicians, who are now able to share their skills with their community. More than 30 local technicians have been trained in animal husbandry, farming, pearl grafting, and accessory making, resulting in the establishment of two new industries in Micronesia.
- Local technicians are operating the College of Micronesia's hatchery at Nett Point in Pohnpei, where they demonstrate their ability to produce blacklip pearl oysters (*Pinctada margaritifera*) and sea cucumbers on a commercial scale.

The CTSA-funded projects also helped advance culture techniques for both black pearl oysters and several species of sea cucumbers.

- Grafting and husbandry methods for oysters have been improved, and researchers confirmed that a better quality pearl can be achieved through re-grafting.
- Larval rearing protocols were developed for sea cucumbers, and several hundred thousand juveniles have been produced for stocking.

CTSA supports...
Innovation and Looking Towards the Future

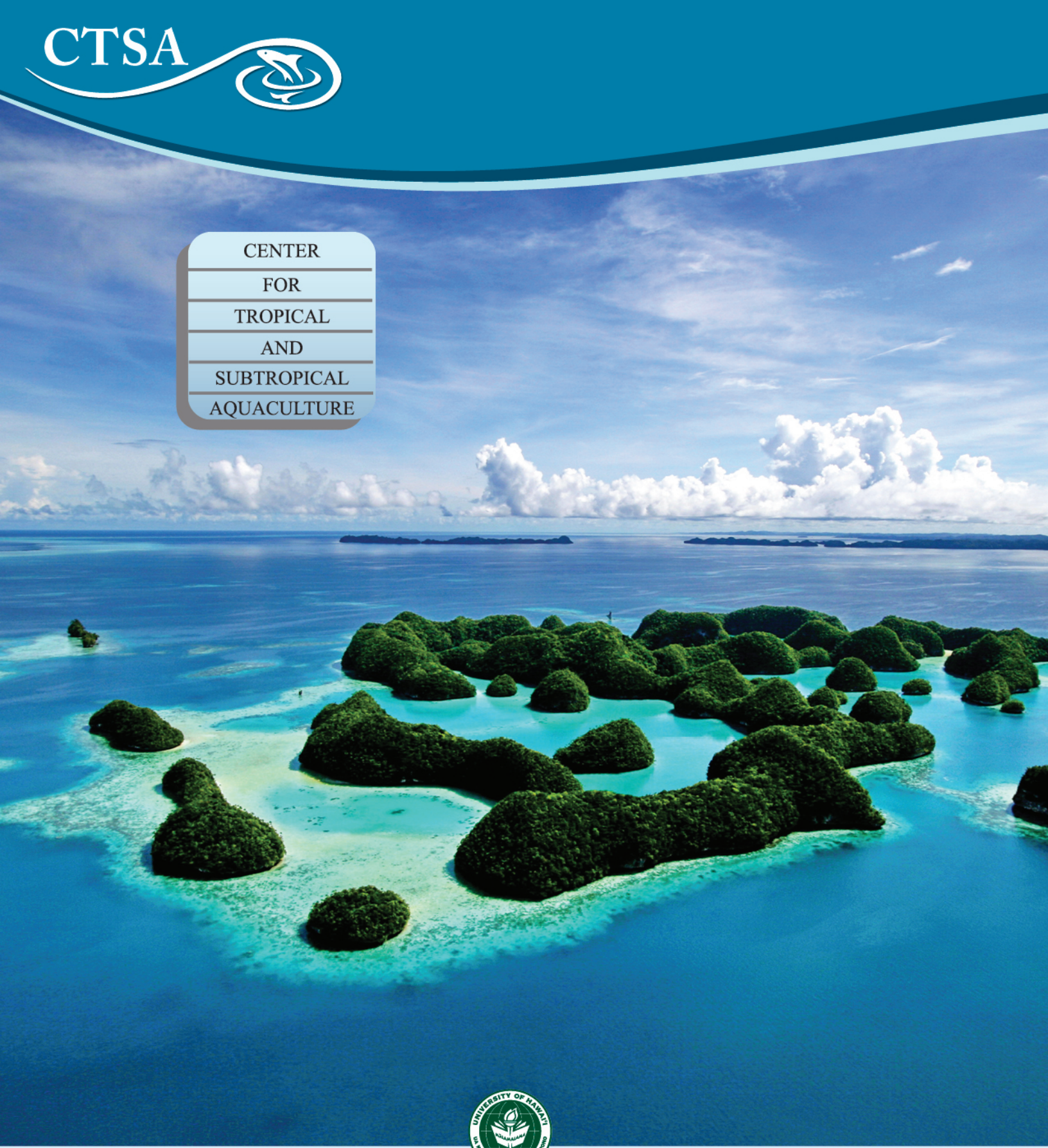
An abundance of natural and human resources make the Pacific Islands an ideal location for sustainable aquaculture development. According to FAO projections, worldwide aquaculture production will need to reach **80 million tons by 2050** just to maintain the current level of per capita utilization. Considering the vast amount of open space in the Pacific Ocean, and the myriad of efficient aquaculture technologies available, the CTSA region has a golden opportunity to help meet the growing global demand for seafood.

Going forward, CTSA will remain focused on applied research, extension, and demonstration to help the region realize its potential. The Center is also working to introduce aquaculture to college students, children, and other groups. An increase in public knowledge and support for the industry can help the Pacific Islands realize the tremendous potential of aquaculture, to both enhance food security and stimulate island economies.

Aquaculture...
On a global scale,
on a local scale,
it makes good sense.

CTSA

CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE



Oceanic Institute
An Affiliate of Hawai'i Pacific University

College of Tropical Agriculture and Human Resources

USDA United States Department of Agriculture
National Institute of Food and Agriculture